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MEMORANDUM

Date: May 18, 1967

To : R. M. DeNio, Director, Division of Range Management
From : A. B. Evanko, Chairman, Range Seeding Equipment Committee
Subject: Improvements

The Range Seeding Equipment Committee's program accomplishment for 1966 and plans for 1967 are itemized in the attached report. Subcommittee reports presented at the Seattle Meeting on February 12-13 are on file in the Division of Range Management, Forest Service.

To the extent possible, the composition of subcommittees and project assignments as determined at Seattle have been followed. Some changes resulted from personnel changes and/or job reassignment. Concerned agencies were consulted in these instances. Subcommittee Chairmen will be provided with a work plan for his respective project(s).

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Enclosure

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**REPORT OF THE TWENTY-FIRST ANNUAL MEETING
OF THE RANGE SEEDING EQUIPMENT COMMITTEE**

**Seattle, Washington,
February 12-13, 1967**

The Twenty-first Annual Meeting of the Range Seeding Equipment Committee was called to order by General Chairman John Forsman at 9:15 A.M., February 12, 1967, at the Olympic Hotel, Seattle, Washington. All of the subjects included in the prepared program were presented to the Committee. Curtis McVee, Bureau of Land Management, A. C. Hull, Agricultural Research Service, and Paul Howard, Bureau of Indian Affairs, introduced the speakers and led the discussion as scheduled in the program. Proceedings were recorded by Ellis J. Callentine, Forest Service. The registered attendance totaled 72 persons, representing Federal and State agencies, colleges, industry, and others from all parts of the United States.

The following are summaries of the reports presented. A copy of each complete report is attached to the original of this report and filed in the U. S. Forest Service Division of Range Management, Washington, D. C.

History of the Range Seeding Equipment Committee.

By A. C. Hull, Subcommittee Chairman.

The Committee had its beginning in 1945 when a Western-wide Forest conference on range seeding was held. At this meeting it was concluded that one of the biggest needs of range seeding was suitable equipment. A Committee was formed to cope with this problem. Because seeding and equipment needs are not confined to land ownership or agency boundaries, the Committee rapidly became interagency with world-wide attendance. For the first two or three years the Committee was exclusively Forest Service. The Bureau of Land Management attended a meeting in 1949 and in 1951 made its first financial contribution in 1955. The Soil Conservation Service attended in 1949 and made its first financial contribution in 1956. Agricultural Research Service first attended in 1951 and have since been active in Committee work.

The early functions of the Committee were to consider, evaluate and assign priorities to the equipment problems suggested by the several Regions. The Committee should draw up a program of work each year for the Forest Service Equipment Laboratory to follow. In addition the Committee would perform an essential function by drawing up specifications for the most desirable type of equipment to be used in range seeding.

In 1949 the purpose of the Committee was enlarged to:

1. Evaluate available equipment suitable for range seeding (and brush control) and, if none is satisfactory, suitable equipment to be designed, constructed and tested under guidance of the Committee.
2. Prescribe specifications and standards for purchase, maintenance, and use of equipment and materials.

3. Function as a clearing house for the interchange of information.
4. Act in an advisory capacity to the Chief's office, Regions, and Stations in range seeding and undesirable plant control policies and procedures.

In 1955 the name "Range Seeding Equipment Committee" was adopted and has been retained. It has been an informal organization with no restrictions on membership or participation. The broad aims of the Committee were redefined as:

1. Keep abreast of the field of commercially-developed equipment and make such modifications as required for wildland use.
2. Develop equipment, if not commercially available, with priority dependent upon the urgency of needs.

The scope of the Committee was soon broadened to include development of equipment for allied activities such as undesirable plant control, pitting, contour furrowing, and water spreading. The Committee does not infringe on the activities of the American Society of Range Management.

Most of the engineering and equipment development work has been done by the Forest Service Equipment Development Centers. Financial support for equipment development at the Equipment Development Center at San Dimas comes from the Forest Service, Bureau of Land Management, and Bureau of Indian Affairs. These agencies and others contribute much time and equipment in field testing and evaluation.

Successfully modified or custom-designed equipment include: Brushland plow, Baby Brushland plow, Rangeland drill, Rockland tiller, alpine equipment, equipment for steep slopes, pipe harrow, sagebrush rails, multiple hitches, pitting equipment, contour furrower, terracing and dike building equipment, seed broadcasters, browse seeder, browse seed collector, and herbicide spraying equipment.

The publications of the Range Seeding Equipment Committee have filled an urgent need. Publications include: Range Seeding Equipment Handbook, Service and Parts Manuals, Chemical Control of Range Weeds, Equip Tips, and other operating hints. In addition to the development of equipment and publications, the Committee has fostered unselfish cooperation among all the agencies concerned.

Report of the Subcommittee on Root Plowing.

By Joseph V. Chiarella, Subcommittee Chairman.

Root plows in the South and Southwest have generally proven to be a successful tool in removing undesirable plants like pinyon, juniper, tamarisk, chapparal association, creosote bush, mesquite, other desert shrubs and cacti. They are being used quite extensively and will continue to play an important role in improving our rangelands.

The Middle Gila River Phreatophyte Control Project on the San Carlos Reservation in Arizona will last for five years and covers 13,720 acres. This project is a joint undertaking by the Corps of Engineers, U. S. Geological Survey, Bureau of Indian Affairs, University of Arizona, and the San Carlos Tribe. The main species to be treated are about 6500 acres of mesquite at a cost of \$30 to \$50 per acre; 6970 acres of tamarisk ranging from \$30 to \$70 per acre and 248 acres of large cottonwood trees for about \$150 per acre. Cottonwoods, of course, will not be treated with the root plow.

Piling, burning and smoothing the surface will be required. In the fall of 1966 about 500 acres were cleared. Presently five root plows and four brush rakes are working steadily on these bottomlands. This area will also be treated chemically after a year or two, and a seeding program will follow.

Parts Stocking for Rangeland Drill and Brushland Plow.

By Joseph H. Sonntag, Subcommittee Chairman.

The year 1966 marked the seventh year of operation for the central parts stock facility at the U. S. Forest Service Equipment Depot, Stockton, California. Forest Service funds provided the financing for the storage facility and parts inventory at the Depot and is operated under the Working Capital Fund.

Total parts, purchases and sales for the last 4 calendar years are as follows:

Purchases, calendar year	1963	-	\$9,439
"	"	1964	- 40,294
"	"	1965	- 26,206
"	"	1966	- 15,103

Sales for 1966 included 73 parts which were not previously stocked by Stockton Depot. Of these, 52 pertained to the Rangeland drill and 21 to the Brushland plow. Response to the semi-annual inquiries for parts is weak; approximately one-third of using organizations have not responded. Effective parts stocking is extremely difficult without these estimates. It is believed that a revised parts requirement and inventory form will help overcome the reporting difficulty.

It has been noted that any parts inventories for 1964, 1965, and 1966 have exceeded the total parts capitalization by \$5000, \$4000 and \$6000 respectively. This trend is expected to continue because of the continued growth of the program.

Two contracts have been let for F. Y. 67 procurement, to be delivered during C. Y. 1967. The first contract is for two full-size drills, one to be delivered to the Tonto National Forest, Phoenix, Arizona, and the other to the Kaibab National Forest, Williams, Arizona. The other contract is for two Brushland plows to be delivered to the Bureau of Land Management, Boise, Idaho.

Existing inventory of range seeding equipment for agency members of the Committee, including current orders, are as follows: Rangeland drills, 221; Brushland plows, 53; and Contour furrowers, 6.

Rangeland Drill.

By Tony Evanko, Subcommittee Chairman.

The following work has been accomplished on the Rangeland Drill Project during F.Y. 1967:

1. A new drawbar of heavier sections was designed, fabricated, and field-tested.
2. The specification for the drill was brought up to date for F.Y. 1967 purchases.
3. Drawings were brought up to date for fiscal year 1967 procurement. In addition to the following listed changes, numerous minor corrections were made to the drawings.
 - a. Detailed drawings of a new and simpler drawbar were completed and incorporated into the drawings.
 - b. Drill wheel spindle taper has been run out further to eliminate a stress raiser, increase strength, and simplify machining.
 - c. Holes on the brush guard were relocated to fit those in the new drawbar.
 - d. The six and one-quarter pound weights were eliminated. The remaining twelve and a half pound weights are now to be made by casting. Cost of the weight will be reduced by approximately 40 percent.
4. The Hammer Blow Coupler No. 5 was found to be inadequate. The ball and socket has limited flexibility, particularly when used with a two-drill hitch. A Holland pintle hook and tow ring were adapted to the drawbar of the drill and tested by the BLM in Vale, Oregon. Observations by the Development Center personnel and reports from BLM indicated this hook and ring arrangement allows more flexibility and solves the problem inherent in the ball and socket type arrangement.
5. New disc opener arms tested in the field show the following results:
 - a. The cone type seed tube tends to become plugged from a brush build-up between the disc and cone. A similar problem appeared in the conventional seed tube with the boot in place.

- b. The disc opener arms with the cast bearing support, without cone nor boot at the end of the seed tube, have had no plugging problems. However, the disc shaft is too long and interferes with the adjacent depth ring; consequently, it will have to be shortened.
 - c. U-bolts and nuts on the bottom end of the seed tubes have broken or become loose. They will need to be relocated, protected, or possibly eliminated.
 - d. Cotter pins on the ends of the disc shafts were broken off. A snap ring or other method of retention is being considered for the disc arms.
6. A second drawbar was designed and built by the Equipment Development Center (see Figure 2). It is basically the same in construction as the first experimental model but for being hinged at the frame. It can be folded back by removing the bolts holding the front of the hitch together. The folded members are pressed against the tires and serve as a brake and safety device. This drawbar will simplify handling and occupies less space. One man is able to fold or assemble it as compared to the three men with the present drawbar. This new hinge type drawbar has been built into the Equipment Development Center's Rangeland Drill.
7. A parking stand has been designed and added to the Equipment Development Center's Drill. It is a simple arrangement for supporting the drill when it is not attached to the towing vehicle. The stand is located in the center on the front member of the main frame. The tool box was moved forward to accommodate the stand.
8. New drawings for the drill are presently underway. The drawings will reflect a new format adopted by the Equipment Development Center; conforming closely to standard commercial practices and more easily read. These drawings will apply to future rangeland drills and will have entirely new parts numbers. Some parts, however, will be the same as for older drills. The latest developments, including those tested recently, are being considered for inclusion in the drawings. These include the following:
- a. New hinge-type folding drawbar, stand, and Holland tow ring.
 - b. It is also planned to use the John Deere method of mounting the grain box outboard bearing on the input feed shaft rather than on the chain cover.
 - c. The rate of rotation of the grain box feed shaft is being reduced by 50% of the present rate to afford better metering and reduced seed damage.

9. Operator's manual for the rangeland drill is complete and ready for publication.

It is planned to complete the new drawings of the Rangeland Drill this fiscal year.

F.Y. 1968 Recommendations.

1. Revise the Rangeland Drill Service Parts Manual to conform to the changes that are presently being incorporated into the new drawings. The part numbers will reflect those assigned in the new drawings. This manual will apply to drills to be constructed from the new drawings. Present drills will use the recently published manual.
2. Field test the new hinge-type drawbar early in F.Y. 1968.
3. The Development Center has received a number of requests for information and drawings for two-drill hitches. It is proposed that the Development Center develop drawings of the two-drill hitch so this material will be available to interested users of the Rangeland Drill. The use of two drills pulled by one tractor is proving to be a definite cost advantage over single drill operation.
4. Modify and field-test cast bearing support disc opener arms.
5. Work with manufacturer in fabrication from new drawings.
6. Assist Stockton on procuring parts.

Interseeding Equipment Trials and Evaluation.

By Ralph Cole, Subcommittee Chairman.

Planned tests of the new trashy seed box and the narrower scalpers were not made. Mr. Hansen, Ephraim, Utah, was unable to provide these items in time to seed.

The seedings made in Harding County, South Dakota, in 1965 resulted in excellent stands. There is no question that the Hansen Browse Seeder is a very fine range interseeder.

The Committee purchased some little bluestem seed for use in the trashy seed box. Part of this seed was sent to Bill Currier to try with the thimble type feed he has been using. The thimble type feed will dispense extremely chaffy seed. One Hansen Seeder has been converted to the thimble type feed. It has been suggested that this feed be handled as optional equipment with the Hansen Browse Seeder. The results of the test with the little bluestem seed are not yet available. The balance of the seed is to be planted in the short pines in the Custer National Forest near Camp Crook, South Dakota.

Brushland Plow.

By Tony Evanko, Subcommittee Chairman.

The major effort this year was concerned with the preparation of the Operators' Manual and up-dating of drawings and specifications for procurement purposes. The Manual is in rough draft form and about 50 percent complete. The Development Center has furnished technical information and advice to Region 5 and contractors fabricating the plow and parts. This information has been incorporated into specifications and drawings for this year's purchase. The following revisions were made to the specifications and drawings:

1. The tapered hole in the steering arm which accepts the Timken rod end was increased to the correct size.
2. The spring lever pins are now made of SAE 4140 cold drawn steel instead of carbonized mild steel. This change resulted in an improved part at less cost.
3. Missing dimensions on the hitch strut were added to the drawing.
4. The material in the land wheel sliding shaft, the land wheel axle and furrow wheel axle were changed to SAE 4140 cold drawn steel shafting from precision ground alloy-steel shafting. This change resulted in reduced cost of parts with no decrease of service life.
5. The land wheel was redesigned, eliminating the Budd wheel which has become unavailable.
6. The rock guards have been incorporated into the drawings and specifications as a standard item rather than an optional item.
7. The approximate weight of cast parts has been added to the drawings to give bidders sufficient information for submitting quotations.

The Development Center has assisted the Stockton depot in parts procurement. In this regard, an effort has been made to reduce the cost of parts by changing material and manufacturing processes and still retain the same or increased service life.

Planned work remaining in F.Y. 67 is unlikely to be realized unless additional funds are provided.

Seeding Equipment Handbook and Equipment Service Manuals.

By A. C. Hull, Subcommittee Chairman.

Status of Present Handbooks:

1. Range Seeding Handbook. The fourth revision of 2,000 copies printed

in 1965. It is available from agency heads. A section covering the pipe-laying machine is being prepared for inclusion in the Handbook.

2. Operating Hints. The second revision of 4,000 copies printed in March 1961. It is available from agency heads.
3. Service and Parts Manuals. Commercial manuals will be used where available.

a. Brushland Plow

Service Manual. 200 copies printed and issued through San Dimas during 1961. Supply exhausted.

Parts Manual. Prepared at San Dimas and 300 copies printed in 1965. It is available at the Stockton Depot. (50 copies left).

New Service and Parts Manual. Being prepared at San Dimas. It should be in review draft by June 30 and completed during F.Y. 1968.

b. Rangeland Drill

Service and Parts Manual. Prepared at San Dimas and typed for reproduction. A few Xerox copies are available, with 600 copies to be printed before June 30.

New Service and Parts Manual. Proposed for preparation at San Dimas in F.Y. 1968 to cover the new 1968 drill design. The present Manual will continue to apply to older drills.

Rangeland Drill Drawbar Modification Instructions. Prepared at San Dimas and 350 copies printed in 1965. Available at San Dimas.

- c. Hansen Browse Seeder. Drawings and parts list prepared at San Dimas and 150 copies printed in 1967. Copies are available at this meeting and from the Hansen Machine Company at Ephraim, Utah.
- d. Contour Furrower. Service and Parts Manual proposed for preparation at San Dimas during F.Y. 1968.
- e. Brush Roller. Equipment Tips proposed for preparation at San Dimas during F.Y. 1968.

4. Chemical Control of Range Weeds. The first revision was printed in 1959. The second revision of 6,000 copies was issued in December 1966. Both are available from the Government Printing Office, Washington, D. C., for \$1 and 30¢, respectively, per copy.

Printing of Handbooks and Manuals:

1. Handbooks will be printed by the Forest Service in Washington. The committee will furnish all plates, drawings, and materials needed for printing. The Forest Service will print the number of copies ordered and each agency will handle its own distribution.
2. Service and Parts Manuals will be printed and distributed by the San Dimas Equipment Development Center, USFS, 444 East Bonita Avenue, San Dimas, California, 91773.

Ground Spray Equipment.

By Tony Evanko, Subcommittee Chairman.

The roller tanker unit was reconditioned and returned to Missoula Equipment Development Center.

Side-Mounted Tractor Unit. Planned work during the year was deferred because of higher priority projects and Development Center personnel shortage. Level gauges were purchased but not installed. Project funds were diverted to the browse seed collector project. Accomplishment during the remainder of F.Y. 1967 is dependent upon additional financing. Consideration is being given to the use of the front-end plow funds (R-3) to adequately up-date specifications and drawings to permit the purchase of a spray unit by Region 3, F.S. In this event, Center personnel will work closely with the fabricator of the spray unit to solve problem areas in drawings and design.

Vacuum Browse Seed Harvesting Machine.

By A. Perry Plummer, Subcommittee Chairman.

A second prototype browse seed harvester was constructed by the Equipment Development Center this past year. In the development of the second machine the Center was instructed to (1) provide a sacking device, (2) provide an air shutoff so the unit could be emptied while the machine was still in operation, (3) develop light-weight collector heads, and (4) design and place air jets in collector heads to aid in loosening seed from the bushes. These commitments were met but harvesting tests on different species were not as complete as was desired. The machine was tested this fall in New Mexico by Region 3, Forest Service, primarily to harvest seeds of fourwing saltbush under varying conditions, and to harvest a small amount of seed of true mountain mahogany.

Major improvement of the first prototype was provision for continuous operation with the installation of a sacker. Provisions were also made for air jets in the collection heads to loosen seed from the branches.

While the new innovations looked excellent, the second prototype was somewhat more disjointed and about 600 pounds heavier than the first. It was apparent that some substantial changes will be required to overcome noted weaknesses. Much more suction will be required at the point of the harvesting heads to remove the seed. Suction was slightly less in the second than first prototype. A larger motor, along with directing the harvested material through the impeller or fan, would vastly increase the suction. This would necessitate considerable redesign.

Frequent clogging of the collection tubes must be overcome. When the first prototype was tested, the opinion was expressed that a hose with a smooth inside surface might alleviate the problem. Evidently this type hose is not available or is not a practical solution. Perhaps an 8 rather than a 6-inch hose would accomplish the objective if more suction would result.

Real difficulty was observed in passing fourwing seeds through the pneumatic tube to the sacker. Overcoming this handicap should not be difficult. More compactness so the machine can be carried on a Jeep or pick-up is virtually "a must" for harvesting many wildland stands. Despite shortcomings, we feel that an efficient machine will be forthcoming.

One of the greatest problems is getting the machine in the field for testing. This could be speeded up by sending field collections of seed to the lab to test machine damage to the seed. Uncleaned seed in lots of 50 to 100 pounds should be sent direct to the Center. Also, we should get information to the Center as soon as possible if we are going to have any seed collection this coming year.

It was recognized at the outset that development of the browse seed harvester was not a simple undertaking and perfection would take time. Certainly we must have efficient harvesting equipment if ample browse seed is to be available for planting large areas in the future. An industry spokesman suggested having a subcommittee project seed needs in an effort to get private industry to help develop a harvester.

Chemical Plant Control.

By Donald R. Cornelius, Subcommittee Chairman.

Two handbooks are now available. Both have the same title and can only be identified by the date of publication. The old handbook, dated March 1959, sells for \$1.00, while the new handbook, dated December 1966, sells for 30¢. In ordering the handbook, you should order by title, which is "Chemical Control of Range Weeds Handbook," and indicate the year. Dr. Dayton Klingman reviewed all write-ups that went into the publication.

Transportation Equipment Evaluation.

By Howard DeLano, Subcommittee Chairman.

The Subcommittee's effort last year was concerned with Bureau of Land Management's method of moving bulky plastic pipe and large metal storage

tanks ranging from 5-18 thousand gallon capacities. Detailed information relative to placement of tubing in the ground and metal tank placement and installation is available upon request from the Range Seeding Equipment Committee.

Fence Building Tests and Evaluation.

By Hallie Cox, Subcommittee Chairman.

The Fury Fencer, attached to a TD-9 crawler tractor, was used to construct 10 miles of fence on the Long Creek District, Malheur National Forest, this past season. Prior to using the machine, the tractor operator was the only crew member familiar with the operation of the Fury Fencer. Time and cost records were kept daily and summarized upon completion of the job.

Operation Procedures.

The TD-9 tractor attached to the Fury Fencer can be backed onto a lowboy for moving from one site to another. This method of transportation is more efficient than loading, hauling, and unloading the units separately.

The 3-point hydraulic hitch is a necessary addition for operation of the fencing machine on any terrain except flat, rock-free ground.

Use of high-tensile wire (cheaper than standard barbed wire) should be a mandatory requirement to reduce wire breakage while stringing and stretching the wire.

Some difficulty with air leaks in the low-pressure (15-lb.) pneumatic tires on the fencer was experienced. Inflation to 40 lbs., and pounding the tire rims to seat the tires, effectively sealed the leaks. The 40-lb. pressure was then used throughout the job.

One section of fence, 6.6 miles in length, was built on terrain that was generally rough and rocky with variable vegetation cover. The following conditions prevailed along the fenceline:

- | | |
|--|-------------|
| 1. Selectively logged area | - 2 miles |
| 2. Virgin timber with second growth understory | - 2.6 miles |
| 3. Open scab-rock flats | - 2 miles |
| 4. 0 - 10% slopes | - 3 miles |
| 5. 10 - 20% slopes | - 2.6 miles |
| 6. 20 - 40% slopes | - 1 mile |

In most instances the fence was constructed up and down hill or along ridges. Some side-hilling was done by stringing the wire with the machine and driving the posts by hand.

Some operational difficulty was encountered on sidehill construction. The machine could not be swung left or right to line up the post driver. The posts were dropped off at their proper spacing and then driven by hand.

Rocky ground posed only a slight problem to post driving. The operator had to be more selective when locating a spot to drive the post. Using a 3-inch by 5-foot pipe sleeve and the fencer, the posts were hammered into the scab-rock flats with a minimum of effort. For a comparison, several attempts were made to drive posts by hand into the rocky ground. It was virtually impossible to drive the posts by hand unless a hole was first punched with a crowbar.

Gate jacks and gates were installed after the wire was stretched. Micro-press sleeves were used to splice the ends of the wire spools together. Replacement of wire on the fencer took about 1/2 hour.

Another section of fence, 3.4 miles in length, was constructed on generally flat and rocky terrain. The cover along the fence varied as follows:

- | | |
|----------------------------------|------------|
| 1. Selectively logged area | - None |
| 2. Virgin timber with understory | - 2 miles |
| 3. Juniper-mahogany | - 1 mile |
| 4. Scab-rock area | - 0.4 mile |

Slopes varied as follows:

- | | |
|------------|------------|
| 1. 0 - 10% | - 3 miles |
| 2. 60% + | - 0.4 mile |

The right-of-way was cleared by the crawler tractor and the fencer was used to construct the fence except for the 0.4 mile of steep, open ground. The steep portion was constructed by hand after the remainder of the fence had been completed. The work on this portion of the fence progressed smoothly and rapidly; the crew was adequately trained and performed in an efficient manner.

Operation Considerations.

1. The most efficient way to transport the crawler and Fury Fencer is by lowboy with the fencer attached to the crawler. Back the equipment onto the lowboy to eliminate damage when unloading.
2. Plan to build a suspension type fence with this machine with posts 70 to 90 feet apart.
3. Locate the fence to provide as many long, straight stretches as possible. Always corner on a tie tree, when available.
4. Locate the fence along ridge tops or up and down hillsides; avoid contouring.
5. Place extra wire and posts along the right-of-way, nail green slabs to tie trees, and build rock jacks while the right-of-way is being cleared.

6. Keep the fencing machine operating. An additional man may be timely to help fasten clips, place stays and to build rock jacks.
7. On long, flat stretches a pickup truck can be used to string the bottom wire to be used as a guide for lining up the fencing machine.
8. Proper threading of the wire spools is essential to prevent wire breakage.
9. Staple hard and fast to tie trees when stretching the wire. Use large 4-inch staples (available from GSA) on intermediate tie trees to allow free passage of the wire.
10. Use weights across swales instead of rock jacks. This allows the weights to raise thus relieving pressure on the wires during heavy snowfalls.
11. After the fence is constructed, you should be able to mash the wires flat on the ground between posts and have them spring back into place, e.g., the fence should be extremely flexible, yet taut.
12. Do not attempt to line up the steel posts precisely, a foot out of line either way adds to the flexibility of the fence.

Operation Costs.

Dollars Only

Lowboy - 197 miles round trip	\$307
Equipment repairs	30
Equipment use	670
Wages - 1½ pay periods (includes per diem)	2457
Materials - wire, posts, nails, staples, stays	<u>2230</u>

\$5694

10 miles of fence at \$569/mile, total costs.

In addition to above, overhead costs amounted to \$864.00. For future projects this cost would drop considerably using a trained crew.

Conclusions.

The Fury Fencer has a definite place in the Forest Service for fence construction purposes. It can save both time and money.

Provided:

1. The machine is used for 3- or 4-wire suspension type fence construction.
2. The terrain is not too severe — as to limit the operating efficiency of the equipment.

3. The machine is operated by a 3- or 4-man trained crew.
4. An efficient sequence of operational procedures is carefully planned prior to using the machine.
5. Use of the machine is limited to projects 10 miles or longer in length.
6. The machine is kept operating while on the job, e.g., use additional manpower as needed to avoid shut-down.

Brush Roller.

By Charles Graham, Acting Subcommittee Chairman.

Only very limited investigative work was accomplished on this project to date. The T. G. Schmeiser Co. of Fresno, California, was contacted by letter. They make a unit similar to the brush roller but the rings are not as large and are made of solid cast iron. One such unit is being used in the Albuquerque, New Mexico, area in conjunction with a seeding device. Accomplishment of project work for the remainder of F.Y. 1967 is unlikely. Project funds were used on other work at the Development Center.

Seed Dribbler.

By Hallie Cox, Subcommittee Chairman.

Two seed dribblers were constructed by Walter Hansen of Ephraim, Utah. The seeders have been used on D-8 Caterpillar Tractors. The seed is metered onto the track pad just as it breaks over the front idler. The seed drops off the pad and is imbedded in the soil by the track grouser as it passes over. The seeder mechanism has a direct drive from a wheel riding on the track. The units have had a considerable amount of use during the past three months. Operation of the equipment has been very satisfactory. It appears to be a sturdy piece of equipment. No difficulty has been experienced with breakage or performance. Nearly any type of seed can be sown with the versatility of the fluted seed mechanism. The units will cost approximately \$300 each. All parts of the machine were manufactured by Mr. Hansen. Region 4, F. S., and the Utah State and Game Department plan to purchase additional units in F.Y. 1968.

Cover Manipulation Project Inventory.

By L. E. Riordan, Subcommittee Chairman.

Project record forms have been filled out for 750 type-conversion projects in Colorado. These represent available information on projects in all of the National Forests except the Grand Mesa-Uncompahgre, and in all Bureau of Land Management Districts except for portions of the Middle Park and Eagle Resource Areas, Glenwood Springs District. No attempt has been made thus far to obtain information about projects located on private

land. Records of some earlier National Forest projects have been transferred to the Central Records Center in Denver for storing. Permission has been obtained from proper officials to examine these records. It is expected that there will be about 850 project records of Forest Service and Bureau of Land Management cover manipulation projects when all available files have been examined. This includes projects completed through 1965.

One difficulty has been that many of the agency project records were lacking some important items. It was discovered that in some cases agency personnel who had worked on the projects were still available and were able to supply some of the missing data.

Upon completion of the record forms, this information will be transferred to IBM punch cards, and it will then be possible to analyze the data in a wide variety of ways to bring out needed facts. It is the hope that a uniform procedure can be worked out with land management agencies by which a record form would be initiated for each cover manipulation project at the time it is being planned or when it is approved. Under existing policies of land managing agencies in Colorado, such project proposals are routed to the Regional Game, Fish and Parks Managers of the Colorado Game, Fish and Parks Department for review and comments on possible effects on wildlife resources.

It is proposed that a project record form with preliminary information be transmitted with the proposed project plans to the appropriate Game, Fish and Parks Regional Manager. After review he would then forward the project record form to the Colorado Game, Fish and Parks Department Research Center, Fort Collins, Colorado, where a central file will be maintained.

Weed Chopper Trials and Evaluation.

By Robert D. Martin.

The weed chopper was again used on the BLM Boise District during the summer of 1966 to dispose of Russian thistle lodged against fences. A modified John Deere 15 Rotary Chopper with a pickup attachment was used. The tractor with direct drive power take-off and straight hitch used in the initial trials was unsatisfactory. Better results were obtained with a three-point hitch and free power take-off on the tractor. The chopper could not be used in the lanes since it was impossible to drive the tractor ahead of the chopper because of the packed weeds.

The pickup attachment can be improved if the vertical bar at the outer end of the pickup was modified with a rotary mechanism to pull the weeds away from the fence. Modification of this machine will be done in the Boise District shop.

The San Dimas Equipment Development Center provided estimates for the construction of additional units if the need exists.

Disturbed Area Rehabilitation.

By Charles B. Waldron, Subcommittee Chairman.

Specific 1966 objectives of the Disturbed Area Rehabilitation Subcommittee were to follow up on reporting results of projects evaluated in 1965 and to continue reporting on various rehabilitation practices used in treating "spoil land" areas and areas disturbed by road construction, logging, mechanical watershed treatment, etc.

Principal guidelines for road cut and fill stabilization include the following.

Seeding of grass species for the area involved generally gave good results. Promising species were Indian ricegrass, Fairway crested wheatgrass, pubescent wheatgrass, smooth brome, Kentucky bluegrass, timothy, hard fescue, yellow and white sweet blossom clover. On many of the one-to two-year old revegetation jobs, extensive damage has been done by livestock and game grazing the new grass stands. Part of the answer will be in the use of less palatable species of grass and control of animal use until a good stand establishment occurs.

Several forests experimented with shrub plantings on these roadside cuts and fills by direct seeding, transplanting, cuttings and potted plants. Generally success was quite poor. Seeding grasses on these areas will result in a better stand and is much more economical. Shrub plantings can be justified only under special conditions involving aesthetic or screening values.

Fertilizers were found to be necessary or desirable on all roadside cuts and fills to establish a satisfactory stand of grass species.

Methods of seeding during the past two years include broadcast seeding, hydromulching and the asphalt mulcher. Broadcasting is the most economical, averaging around \$20 per acre. The hydromulcher gave better results at a much lower cost than did the asphalt mulcher. Costs on the hydromulcher varied from \$75 to \$175 per acre, while the asphalt mulcher was well over \$200 an acre.

The desired method is to broadcast seed as soon as the slope is ready, then follow up with the hydromulcher within a year to catch the steeper slopes and areas not vegetated from the broadcast seeding. The key to success is twofold: have the slope rough like a disked field, and use fertilizer.

Spreading of top soil over the disturbed area is not justified on roadside bank stabilization work, except on very special areas or where top soil can be readily stockpiled. It is more expensive than using the hydromulcher.

Some forests have used up to 40 pounds of seed mixture per acre. No better stands resulted than when 15 pounds per acre were used. It is

recommended that broadcast methods should use 12 to 15 pounds of seed per acre. A rate of 8 to 10 pounds of seed should be used with the hydroseeder per acre, which is similar to that for drilling.

Results of specific projects are available in the complete report on Roadbank Stabilization on the Boise National Forest, R-4, and the Mt. Hood National Forest in R-6. Also included is information on the stabilization and rehabilitation of mine tailings and mill wastes.

Front-End Plows Testing and Evaluation.

By Dick Monteith, Subcommittee Chairman. (Report given by Bill Currier).

No work was done on this project in 1967. The front-end plow was designed primarily for construction of contour trenches. Last year the main problems encountered were poor operator vision and sod fouling - resulting in a poor furrow. The ripper will probably replace the front-end plow.

Extended Lubrication Intervals.

By Joseph A. Sonntag, Subcommittee Chairman.

A summary of the results of this Subcommittee indicates that:

BLM - Vale Oregon.

1. An extension of lubrication intervals from 4 hours using conventional greases to 2 days using molybdenum disulphide fortified lithium base (moly-lube) greases on brushland plows and range-land drills. It appears possible to reduce downtime for lubrication without affecting equipment reliability.
2. Trial use testing of the 2-day lubrication interval should be continued to determine if present evidence can be substantiated.
3. Trial use tests with 5 and 3-day lubrication intervals resulted in lubrication problems that appear to have been eliminated with the 2-day lubrication interval noted under 1. above.

Modoc National Forest.

1. Results of 3 - 4 day extended lubrication intervals with moly-lube grease after two seasons (1965 and 1966) continue to be favorable.
2. Trial use tests should be continued to provide further evidence.

Goosenest District - Klamath National Forest.

Lubrication intervals were started on the District last fall. Results should be included in the final review of the program next year.

Spray Project Boundary Marking Methods.

By Carl M. Rice, Subcommittee Chairman.

Methods used to date to mark project boundaries include flour, lime, balloons, streamers, and ground panels. Two more recent methods include a multi-streamer and the spraying of the top of the tree with a highly reflective paint from a helicopter.

Methods used in swath marking include aniline dyes, balloons, lights, smoke pots, mirrors, streamers, radio system, and flagman. Flagging and ground panels are still most commonly used to mark boundaries in low brush areas. In timbered areas the newly developed multi-steamer and the painting of tree tops from a helicopter appear to be a definite improvement over the previously used methods.

Of the different methods used for swath marking, flagmen are still the most satisfactory. Flagging materials have improved as far as visibility is concerned. The "Automatic Flagman" may be a more accurate means of marking swath lines. An evaluation of it will be made in a sagebrush area. At present it can be mounted on certain types of fixed wing planes. Helicopter mounting is to be investigated.

Site Preparation Ripper.

By W. F. Currier, Subcommittee Chairman. (Oral report given by Dick Monteith).

The purpose of the ripper is to economically prepare large blocks of land for tree planting and browse seeding. It may also have value for ripping aspen stands to induce sprouting. The ripper will scalp just below the surface to a width of about 20 inches and up to a depth of 18 inches. A drag behind the ripper replaces and compacts the soil over the trench. The ripper is particularly suited for treating rough and rocky ranges for moisture penetration and retention.

The development during 1966 consisted of modification to improve ripper penetration. The problem with the original model was the need for large amounts of ballast to obtain ripper teeth penetration. Changes in soil compaction or sub-surface rock caused the tooth to come out of the ground. Re-entry would not occur for long distances.

The problem was discussed with the San Dimas Equipment Development Center. It was recommended that the tooth draft angle be reduced to approximately 20 degrees. This was done as well as the following additional modifications:

1. Raising the vertical pivot to 18 inches to provide additional ground clearance.
2. Changing the ripper tooth angle adjustment to incorporate a wedge.

3. Changing the drag connections to the rear of the tooth carrier.
4. Modifying lifting system to provide uniform lift.

Testing the modified ripper was accomplished on the Carson National Forest in December 1966. The site selected for the test was frozen hardpan with buried rock varying from first size to over 3 feet in diameter.

With the new reduced draft angle, penetration into this frozen rocky soil was immediate. A penetration of 15½ inches was achieved and this remained fairly constant regardless of soil conditions encountered.

We feel the geometry of the unit is now correct and that these tests prove the feasibility of this type ripper.

Scalpers were not used during the test. They were removed during modification and by oversight were not reinstalled.

Future development of the ripper will consist of only detail design changes to include reducing the weight of the unit and investigating the use of standard available structural material for fabrication of the unit.

Anchor Chain Modifications, Testing and Evaluation.

By John K. Chambers, Subcommittee Chairman.

The plan for 1966 was to test a chain modified by the Ely District (BLM) and other chain modifications made elsewhere. Particular emphasis was to be given to tooth design for welding onto chains. The overall purpose was to improve the anchor chain and make it more efficient in eliminating undesirable brush and trees.

Effectiveness of chaining as a means of reducing undesirable woody cover by various agencies was reported. The following evaluations by location follow:

Texas. (SCS report).

1. Mesquite - Chaining of previously chemically sprayed stands over 3" diameter resulted in 50 to 60% pull-out of crown. Soil was moist.

Unsprayed mesquite of the same size averaged around 20 to 30% uprooting depending on moisture and soil. Trees on sandy loam or shallow soil pull better than those on deep clay. Trees pull much better when soil is moist or wet and where chemicals have affected the root system.

2. Juniper - Thirty to fifty percent uprooting occurred in stands three or more inches in diameter on smooth shallow soil. Top reduction of smaller, many-stemmed plants is about 30%.
3. Low brush, pricklypear and tasajillo - Top reduction usually is 20 to 40% depending on size and age of brush. Pricklypear is reduced about 50% in volume (hand spraying is cheaper). Tasajillo is reduced 50 to 100%, depending on weather, timing, etc. Considerable variations exist.
4. Follow-up - Most woody plants in Texas resprout, thus resulting in more denser stands than initially requiring follow-up by other methods. Chaining is a merely temporary treatment in these cases. However, chaining reduced cost of subsequent treatment by other methods in some situations.

Utah. (Department of Fish and Game report).

Best chaining results were obtained using a D-8 size or larger tractor. The best combination has proved to be one with a chain approximately 220 ft. long. Weight of the chain should not exceed six tons. The 90-100 ft. center section should be made up of 70-90 lb. links. A lighter chain of around 30 lbs. per link is suitable around the periphery of project areas. In addition, swivels located between 10 and 15 feet from the chain ends allow the chain to roll and thus clean itself.

Car axles welded on a 60-foot section in the middle of the chain resulted in more soil disturbance. However, this modification also caused some difficulty during the second chaining. The "teeth" prevented the chain from cleaning and large piles of brush would accumulate.

New Mexico. (Forest Service report).

One thousand acres of even-aged juniper averaging 406 trees per acre, and about 14" DBH, were chained. Estimated kill is 70 percent. The anchor chain used weighed 70 lbs. per link. About 250 ft. of this was pulled by 2 D-8 cats in a single loop hookup. The following factors are important in obtaining acceptable control of juniper by chaining:

1. Confine chaining to even aged stands. In a mixed age and size class stand, little damage is done to the smaller trees.
2. A constant speed is essential as compared to a see-saw action of the chain. This is why D-8 crawlers were used.
3. Heavy anchor chain has given better results than a cable.

Nevada. (BLM report).

Tests involved 160' of 90-lb. link chain with various improvisations such as welding angle iron to the center 50' section, several types of

teeth, etc., to increase uprooting action. A D-7 and D-9 were used to pull the chain. Pulling patterns were also varied. Results indicated a reverse "J" to be the most efficient. Swivels were used to attach the chain ends to the tractors. Areas were double-chained in opposing directions.

Approximately 50 percent of the big sagebrush stand was removed in the first pass; an additional 20 - 30 percent of the remaining stand with the second pass. Wear of angle iron teeth and 4-inch chain link projections was excessive after about 200 acres of chaining. Effectiveness was reduced drastically; realizing but 45 percent brush removal by twice-over chaining.

Thirty-pound rail teeth were welded to the links (projecting about 4 inches on either side of the link) on the outermost 40 feet of each end of the chain. This was used on an additional 1000 acres and double chained. Pulling pattern was similar to the foregoing. Seventy-five percent of the brush was removed by the straight portion of the chain and about 45 percent in the loop of the "J".

Total cost of 2-way chaining approximated \$3.50 per acre.

Brush-Cutter-Chipper Equipment. (Tree-Eater Project Report).

By Tony Evanko, Subcommittee Chairman. (Report presented by W. F. Currier).

Additional tests of the Tree-Eater were conducted in May on the Payson Ranger District, Tonto National Forest. Cover of the test area was typical Southwest chaparral.

During the field test, an effort was made to establish safe operating limits for side hill and up and down slope conditions. Soils were decomposed granite with scattered loose rocks up to 10 inches in diameter. A dry and fairly loose soil condition prevailed.

Side hill operations should be limited to 20 percent maximum. When operating above 20 percent side slope, any loss of traction by the downhill track (due to going over a rock, log, or loose soil) causes the front or back of the unit to swing downgrade with a temporary loss of control.

Downhill operation should be limited to 10 percent slopes. At grades above this figure the operator can lose control of the unit; thus overloading the cutting drum if a large tree is encountered. The major reasons for control limitations are: The Tree Eater approximately doubles the total weight that the Case 750 tractor's brakes must control. Also, when the brake pedal is depressed, the engine power (drag) is automatically disengaged on that track. An additional problem occurs when both brakes are used simultaneously. Since both brake pedals are operated with the same foot, it is impossible to control the amount of braking applied to individual tracks. Grades steeper than 10 percent can be negotiated by working uphill and backing downhill.

The unit can be operated on slopes of up to 35 percent when working upgrade. If only light brush of 6-inch stem diameter is encountered, it may be possible to operate on slightly steeper slopes. With larger material it is not possible to slow the forward travel of the tractor enough to prevent overloading the cutter and maintain the tractor's engine speed sufficiently to prevent stalling. A 35 percent gradient is also near the maximum for control while backing downhill. A higher ring and pinion gear ratio would increase control during an uphill cutting operation.

During the test, and while in use over a 12-month period on the Tonto National Forest, the Tree Eater has fully demonstrated its ability to fell trees and fully masticate all but the main stem (10 inches in diameter and over) of the larger, tougher species. Brush, including chaparral and trees of 6-inch basal diameter, are nearly completely shredded and reduced to a mulch consistency. No limit has been determined for the maximum size of tree that can be felled with the machine. Oaks, junipers and pines up to 24 inches in basal diameter have been felled by a good operator.

In determining specific uses for the Tree Eater, it will be necessary to consider production rates and operating cost. Based on measured test sites, the following production rates can be considered average for a skilled operator. These rates do not include any nonproductive time other than maneuvering and turn-around time.

1. Dense chaparral, including oaks, juniper and manzanita - mainly 6 feet in height or under; stems 8 inches in DBH or requiring more than 0.2 minutes to fall not included. .8 to 1 acre/hr.
2. Same as No. 1 only including the time to fall and limb trees of 8 to 14 inches DBH, average 30 trees per acre. .5 to .6 acre/hr.
3. Same as No. 2 but including extra time due to working approximately 25% of the areas with steep slopes up to 35% grade. .4 acre/hr.
4. Pine strip thinning: average 17,000 trees of an average 1.4 DBH per acre. .5 acre/hr.
5. Slash disposal - heavy ponderosa pine slash 2 years after logging, approximately 909 cubic feet of debris. .8 to .1 acre/hr.
6. Juniper stands - trees either cabled or standing, average three to four hundred trees per acre, 35% canopy coverage. Average height 8 feet, crown 6 feet diameter. No attempt to reduce stumps completely. 1.2 to 1.4 acre/hr.

The estimated average operating time is five hours per eight-hour day with the present unit working in decomposed granite under dry, dusty conditions which create the need for increased machine maintenance and servicing. This would include time required to replace worn cutting knives, skid shoes, fueling and lubricating the tractor and Tree Eater, and servicing the air cleaners. The Tree Eater requires a two-man team; an operator and an assistant operator for relief and swamping.

Although the Tree Eater is a highly effective machine in its present state, there is a need for additional refinement to reduce high maintenance requirements and to improve operator working conditions.

A high rate of wear on cutting hammers occurs when working in dry, abrasive soils. The type and method of hard facing used to rebuild the cutting bits is influenced by the soil condition. The type of woody material does not seem to greatly influence the wear rate.

While working in chaparral growing in decomposed granite in the Tonto National Forest, cutting hammers, supplied by the manufacturer and certain hammers rebuilt with hard facing by local shops, lasted a maximum of 60 hours before rebuilding. One set of rebuilt cutters lasted only 20 hours. These were built up, using alternate passes of hard rod and low-hydrogen rod. The minimum welding shop cost for rebuilding a set of 70 cutters is \$140.00 in the Payson-Phoenix area. This figure could vary, depending on locality. A set of rebuilt cutters lasted approximately 90 hours in a clay soil.

There is a need to evaluate various types of hard facing materials and methods of applying them to establish the best combination to extend cutter life to at least 100 hours. Also, the number of times a cutting bit can be rebuilt seems to be limited. A set of hammers that have had the bits rebuilt four times showed a tendency to break at the hammer-to-bit weld as well as the bits breaking more frequently. After the third rebuilding the old bits should be cut from the hammers and new bits welded on. These problems could also be overcome by developing hammers that would accept replaceable bits held by a mechanical means.

In addition to general cutting bit wear, excessive wear and damage occurs to the outside rows of hammers on the right side of the machine that is always worked in the brush. The belt side of the machine is kept to the outside to prevent damage to the belt drive. The damage that is occurring is: bent hammers, cracked welds at the hinge boss to drum weld and badly worn hammer bushings.

The damage and wear is due to soil, rocks and limbs working between the outside teeth and the brush guide to create a bending and thrust loading on the teeth. Excessive wear has also occurred to the track rails of the tractor and may need replacing after the second year of operation.

The fire-starting potential of the machine is considered very high. Sparks from the tracks and cutters result when working in rocky ground. The cutting drum's drive engine is not equipped with a suitable spark arrester and muffler. The high current capability of the electrical system (four six-volt batteries in series) can cause wiring insulation to burn almost instantly when a short occurs.

Dust is a time-consuming and irritating problem. The dust is from two sources, soil dust and wood fibers produced by the cutters working on dry material. The dust cloud in front of the machine often reduces the operator's visibility to near zero. The minimum protection for the operator is a helmet supplied with filtered, conditioned air. A much better system would be a dust-proof cab supplied with fresh, cool air. This would allow the operator more freedom of movement and allow him to use ear-protective devices. Noise levels run over 95 decibels at 25 feet from the machine.

Because of the high noise level and poor visibility, it would be very helpful and safer if a two-way radio communication system could be developed for use between the operator and swamper.

The early problems with the Vee belt drive have been pretty well overcome by the use of the Gates "Power Band" belts. However, these must be kept at the proper tension to prevent slippage. The belt housing must also be sealed to prevent trash from coming into contact with the belts or their backing.

An oral report was made on the Tree Crusher by Bill Currier, followed by a film narrated by Joe Shipman of Bates, Inc. The Tree Crusher, or Bates Crusher, was developed by Bates, Inc., Albuquerque, New Mexico. It is a 150,000-pound machine designed for clearing lands of trees and brush. It travels at a constant three miles per hour and has three 7-foot diameter wheels having 6-inch hardened steel blades set at one-foot intervals diagonally across the surface of the wheels. An adjustable push-bar, 27 feet wide, is suspended in front of the machine and controlled by the operator. The bar pushes over and uproots the tree, the knife blades chop and cut limbs, roots and smaller trunks into short lengths, leaving a compact level area of debris. Large amounts of debris can be burned if it is desired to place the land into cultivation before the woody material deteriorates. Only the largest tree trunks will then need to be removed from the land.

Several projects have been treated with this unit in the past few months and are available for inspection by interested parties.

Approximately 200 acres of saltcedar, cottonwood and other vegetation were cleared for the New Mexico Boys' Ranch a few miles north of San Bernardo, New Mexico. Approximately 75 acres of pinyon and juniper were cleared on Forest Service land near the Bernalillo County sanitary fill

area off South Highway 10 and in Tijeras Canyon near Albuquerque, New Mexico. Approximately 10,000 acres of pinyon-juniper have been cleared on the Bonita Allotment, 10 miles west of Corona, New Mexico, in a joint venture between the permittee and the U. S. Forest Service.

Operation of the machine is limited to slopes not over 20 percent and will not work in large rock. It is adapted to dense stands but is not as cheap as cabling.

Poison Grain Dispenser Trials and Evaluation.

By Gordon Powers, Subcommittee Chairman. (Oral report by Paul Howard).

Amount of Use in 1966.

Sport Fisheries and Wildlife

3300 acres in Arizona; some limited use in Utah.

Bureau of Indian Affairs

1500 acres in South Dakota; more was planned but not accomplished because of black-footed ferret and other reasons.

Problems Encountered.

No reports of trouble with the dispenser. Some scooter trouble if front wheel is small. It can drop in holes and up-end the rider. Scooters with large front wheels are probably best. Both scooter and dispenser can suffer damage if not securely fastened in transit on trailers or trucks. Inexperienced riders are not very efficient.

Recommendations.

There appears to be no particular problem with the dispenser. Continued evaluation for another year is suggested. No funds required.

Exploratory and Historical Review Committee Report.

By Curtis McVee, Subcommittee Chairman.

This Subcommittee has two functions: (1) preparation of a historical index. This consisted of cataloging approximately 90 implements. The 1966 activities concentrated on the collection of photographs. Approximately 15 projects still lack suitable photos. The final draft is now in the process of typing.

The second function is collection and evaluation of proposals for developing and testing new implements and analyzing problems that may require development of specialized equipment. There were nine proposals last year and five new Subcommittees were appointed.

This year, one proposal was presented for consideration. It dealt with livestock spray paint, the marking material itself, and application equipment. After some discussion it was decided that this was not a project for this committee at this time.

Browse Seeder.

By A. Perry Plummer, Subcommittee Chairman.

Continued improvement of the seeder by the manufacturer, Walter Hansen, Ephraim, Utah, has resulted in a superior seeding implement. The seeder has the capability of dispensing seed of shrubs, trees, forbs and grasses. Competing herbaceous species is eliminated in the seeding process. It can be used under a wide variety of conditions.

Seeding units can be quickly adapted to planting with various types of furrowing equipment. Units have been used in tandem on cheatgrass ranges by the Elko District, BLM. The Manti-LaSal National Forest has used individual units mounted to the rear of road ripper teeth.

Thirty-five seeders are now in use and reported to be operating satisfactorily. Based on use, the double moldboard opener or 16-inch scalper should be considered standard equipment. Cost per unit is \$900. Numbered parts sketches are available at the San Dimas Center to facilitate parts purchasing.

Technical Services.

By Elmer Hokanson.

The following services were performed under this project in addition to miscellaneous correspondence:

1. San Dimas Equipment Development Center personnel observed equipment in operation or visited problem areas with field personnel discussing equipment use and made follow-up investigations involving the following items:
 - a. Rangeland Drill Hitches and Carriers.
 - b. Tumbleweed Chopper.
 - c. Contour Furrower.
 - d. Rangeland Drill Service Manual.
 - e. Rangeland Drill Modification for Interseeding.
2. Preparation of material and participation in the Seattle meeting.
3. Miscellaneous expenditures.

a. Rangeland drill hitches and carriers	\$ 200
b. Tumbleweed chopper	250

c. Contour furrower field inspection & photography	350
d. Rangeland drill service manual	300
e. Handling and shipping casting patterns	128
f. Investigate rangeland drill modifications for interseeding	220
g. Miscellaneous correspondence, travel and drawings	750

3. Seattle Meeting

a. Authors and review costs	1400
b. Illustrations and photography	549
c. Preparing photo of final reproduction copy	224
d. Printing processes (Xerox and final)	369
e. Salary, travel and per diem	600

\$5240

Model B Contour Furrower.

By E. E. Hokanson, SDEDC

Most of the improvements of the Contour Furrower were made as a result of information obtained from field personnel. By informing the Equipment Development Center of the problems in field operations, the equipment could be modified and redesigned. The EDC personnel were also able to make field trips due to these problems, and observe land conditions, furrowing methods, and equipment problems. As a result of these visits, several modifications were made to the units and all the innovations that proved to be beneficial were recorded and included in the Equipment Development drawings. Drawings have been completely redone. Format has been changed to include zoning and list of material on each sheet. This will aid manufacturers in expediting fabrication since it conforms to standard commercial practices.

Some of the items on the old drawings were revised and some new items have been added. Especially significant are the hydraulic arrangement and cable lift mechanism. The hydraulic system had to be redesigned when the cable lift mechanism was added to allow either hydraulic or cable lifting of the unit and still utilize the live drawbar features. The cable lift mechanism has been designed as an optional item. Numerous other items have been revised, eliminated, or added which are listed in this report. An innumerable number of corrections were made. Some of these were found during fabrication. Most are minor and consist of dimensional and material list errors.

Accomplishments.

Specifications for fabricating the contour furrower have been revised and brought up to date. These specifications will apply to the new drawings.

The 20th annual meeting of this committee recommended design modifications which have been accomplished. These are as follows:

1. A mechanism for elevating the furrower by cable from the tractor has been designed and included in detail on the new set of drawings. The system consists of an arrangement of a 3/4" wire cable powered by a tractor winch through a set of two 10" 5-pulley blocks.
2. The sub-soiler shank is shown on the new drawings with a material listed as "T-1" steel which is a high tensile 115,000 to 135,000 psi steel. It possesses a yield strength (100,000 psi) about three times that of structural carbon steel previously used.
3. The structural members of the dammer frame have been changed from 4 X 5.4 lb. high tensile channel to 4 X 4 X .180 wall MT 1010 mechanical tubing. The advantage is in a better section modulus in the tubing with increased structural strength.
4. John Deere grain box number BW10193W is listed on the new drawings with detail for modification and mounting. This box is more readily available than the box used previously.
5. Indexing mechanism is shown more completely in the detail and assembly drawings. Better bearings are included and grease fittings are located in appropriate places.
6. Dowel pins in the disc shaft flange are provided to prevent slippage and reduce wear and breakage of the shaft.
7. The hydraulic system has been completely redesigned and shown on the new drawings. The override system has been retained for effectiveness with or without a tractor hydraulic system.

In addition to the above accomplishments, the following modifications have been included in the drawings:

1. Main frame members have been strengthened by increasing thickness and length of front tubing gussets and rear-end gussets.
2. Ripper tooth now specified is a commercially available item. It is an H&L Company forged tooth. It has been used on the Arizona strip without difficulty.
3. Knockout holes for the disc bearing are shown. This will expedite disassembly of the disc bearing unit.

4. Additional material is designed into the disc shaft flange for added strength.
5. The hitch couple material thickness is increased to three inches. It will allow the couple to fit more closely into tractor hitches in addition to increasing load capacity. The previous 1-1/2" thick material proved inadequate in field use.
6. Flange bearings for the trip lever shaft are added to allow for better action on the dammer trip.
7. The tool box is listed as a commercial item. It is one supplied by Caterpillar on their heavier tractor.
8. Availability of the Veeder Root odometer has been a problem. Manufacturers of the Contour Furrower have had to wait six months for delivery in some cases. Another odometer, the Engler Hubodometer, which is an off-the-shelf item, is more versatile and is now specified in drawings.
9. Additional braces are added to give the seed box better support. Reports from the field indicated a need for better bracing.
10. To supplement the cable lift mechanism, a cable guide was designed and included in the drawings. This guide is part of the cable lift assembly.
11. Field observations indicate that debris has been accumulating between the wheel arm and chain which drives the trip mechanism. Protection from large rocks and other obstacles was needed; therefore, a chain cover has been added.

The old drawings were incomplete in many respects. It was found that more assembly drawings were needed to assist in shop fabrication and in field maintenance. Additional views of some items have been added to the drawings for clarification.

1. The disc bearing standard is shown as an assembly. It reflects a right and left hand assembly in relation to the frame.
2. A disc assembly is shown in two views. One of these is a section cut-away.
3. The timing and tripping mechanism assembly drawing has been expanded and shown in more detail giving a more complete view of the mechanism.
4. The seed box parts and assembly is detailed completely. This should greatly assist the shop work.

A total of twelve sheets of drawings were produced which shows the above accomplishments as well as the rest of the parts. The prefix number for these drawings is RM 25. The number change was necessary to prevent confusion with the old drawings although some of the parts have not been changed.

Proposals.

Proposals for the fiscal year 1968 are as follows:

1. That a parts manual be published and distributed to users of the contour furrower.
2. That a maintenance and operating manual also be published and distributed. The "Maintenance and Operation Instruction" manual presently used is obsolete.
3. That some spare parts be stocked at Stockton. Presently, whenever spare parts are needed by field personnel, the Equipment Development Center in San Dimas is requested to contact the manufacturers. Usually the parts are fabricated as they are requested. This is a time-consuming procedure that neither field nor Development Center personnel can afford.

Contour Furrower Ripper Drawbar.

By E. E. Hokanson, SDEDC.

Introduction.

The practice of preceding the Model B contour furrower with a combination heavy duty ripper drawbar has had a significant influence on maintenance and operation costs in Montana. Maintenance costs have decreased from \$1,000.00 to less than \$200.00 per annum. Operational costs have decreased from \$15.30 per acre to \$7.54 per acre. It is believed that these savings are primarily due to use of this ripper drawbar. Much of this savings can be attributed to less down time; hence, lower maintenance costs.

Since the ripper drawbar has become an integral part of the contour furrowing operation in Montana, R-1, F. S., requested that the San Dimas Equipment Development Center investigate the availability of commercial heavy duty rippers applicable to this use.

Special requirements placed on the ripper are that the spacing of the ripper teeth be 59" and that the ripper be capable of towing the Model B contour furrower.

Towed Ripper.

There are presently no towed rippers commercially stocked. Southwest Welding and Manufacturing Company of 3201 Mission Road, Alhambra, California, has in the past custom made some rippers of the towed variety. The three models for which they retain tooling are shown in Table I.

Table I

Model	For Caterpillar Tractor Size	Weight lb.	Estimated \$ Price
RL	D6 - D7	5,000	3,275
RML	D7 - D8	7,500	4,200

These rippers could be delivered with any tooth spacing the customer desires, as well as other modifications deemed necessary. All the above rippers are cable operated units.

A ripper of unknown make, suitable for use with a D7 size tractor, can be purchased for \$750 from Shepherd Machinery Co., 3400 So. San Gabriel River Parkway, Los Angeles 22, California. This company estimates that it would cost no more than \$500.00 to convert this unit to the 5 ft. tooth spacing required. A larger LeTourneau ripper, suitable for D8 size crawler tractor, costs \$1,250.00 and the same conversion cost would be necessary. Both rippers are cable operated units. A conscientious search of commercial literature, construction trade magazines, the California Polytechnic College Library, and through personal contact with a good number of experienced construction equipment operators and sales engineers reveals that no hydraulically operated towed rippers have ever been produced.

A further problem has been reported in the use of towed rippers. This is the difficulty encountered when the ripper is lifted and the furrower is not. The awkward angle the furrower thus assumes causes the dammer to be dragged hard against the ground. Lifting the dammer arm with a secondary cable has been tried, but this is not a fully satisfactory solution, as it leads to excessive stress on the furrower rear section. In order to successfully lift both the hydraulically operated furrower and the ripper, a hydraulic unit and a cable drum must be installed on the tractor. A tractor equipped with two cable drums is necessary if the newly designed contour furrower with optional cable lift is used.

Tractor Mounted Rippers.

All of the major tractor manufacturers and several accessory manufacturing companies manufacture rippers designed to mount directly to tractors in the D7 size class. To mount a ripper on a tractor of this size class would cost on the order of \$5,000.00 providing the tractor was already equipped with hydraulic control system. Two problems arise, however,

in using a tractor mounted ripper. The first of these is the five foot ripper teeth spacing requirement. The second is the difficulty in towing the contour furrower with the ripper in operating position. Of the generally available commercial rippers, the easiest to convert to 5 ft. spacing would be the ATECO. This is a fabricated unit, and the ATECO representative at Shepherd Machinery Co. stated that if the ripper were ordered new, very little extra cost would be incurred by deviating from standard tooth configuration.

The second difficulty arises from the fact that the ripper bar interferes with the tractor drawbar hitch. A special tongue extension would have to be designed and fabricated specifically for each tractor-ripper contour-furrower combination. Table II presents the most commonly available tractor mounted rippers for use with tractors of the Caterpillar D7 size class.

TABLE II

Representative Tractor Mounted Rippers for
175-200 HP Class Tractors

TRACTOR	RIPPER	2-tooth Spacing	Relatively convenient to:	
			Alter Tooth Spacing	Attach "U" Bracket
Caterpillar D-7	ATECO HRD7E	86	yes	yes
	Caterpillar No.7	78	no	no
International Harvester TD-20	THCTD-20	?	yes	yes
	ATECO	86	yes	yes
Allis Chalmers HD-16	A-C TR-16	36	yes	no
	ATECO HR-HD16	78	yes	yes
Case 1150	ATECO HR-1150	60	-	yes
Euclid 8230-C6	ATECO HR-C6	56	-	yes
	Euclid C6	55	-	yes

Vibratory Ripper Teeth.

There are now no true vibratory ripper tooth systems commercially available. The American Tractor Equipment Corporation (ATECO) of Oakland, California, manufactures a device called "Vyba-Mount." According to Mr. Al Kant, Vice President, Engineering, of ATECO, this is more a tractor-saving, shock-absorbing device than a real attempt at applying vibration to heavy duty ripping.

Although a good number of experiments have been conducted and are being conducted along these lines, the general consensus of experts contacted

in regard to this problem is that the vibratory tool concept has not progressed to the state where it is applicable to heavy construction equipment, such as rippers.

Summary.

An extensive market search revealed that (1) there are no towed rippers commercially available as stock items, (2) cable operated towed rippers can be obtained to special order, (3) used towed rippers are available quite inexpensively at various machinery lots, and (4) the application of a tractor mounted ripper to pre-ripping for contour-furrower use would be extremely expensive and difficult.

Vibrating Plows for Burial of Plastic Pipe.

By E. E. Hokanson, SDEDC.

Personal contact has been made with the John Deere Company and the Euclid Division of General Motors concerning the applicability of the vibratory tool principle for direct burial of plastic pipe. Sales engineers from both of these organizations have stated that this principle has been investigated. Available information will be provided upon summary.

Correspondence contact has been made with the following companies and organizations, and replies from all are expected presently.

- Illinois Bell Telephone Company
- Gagney Enterprises
- Ulrich Mfg. Co.
- Diggers, Inc.
- The Wyatt Mfg. Co.
- Davis Mfg. Co.
- Midwest Lawn-Saver Equipment Co.
- International Harvester Co.
- National Tillage Machinery Laboratory of the U. S. Dept. of Agriculture
- The Charles Machine Works, Inc.
- American Tractor Equipment Co.
- Vibra-Tools, Inc.

This is a complete list of the manufacturers of vibratory tillage tools, as far as can be determined.

Of the above manufacturers, Charles Machine Works and Vibra-Tools have so far responded. The units offered by both of these companies possess a maximum depth capability of 30 inches and a maximum pipe size capability of 1½ inches o.d. These units were developed primarily for use in burying residential electrical and telephone cables.

Midwest Lawn-Saver Equipment Company has experimented with vibrating the tooth on their "Interline-11" cable plow. This is a large unit, capable of buying 4½ inch o.d. pipe to a depth of 42 inches, weighing 5,900 lbs., and normally pulled by a prime mover of 25,000 lb. GVW. Midwest reports that vibrating the plowshare through an arc of approximately 3/8 inch at a frequency of 15 cycles per second reduces the drawbar pull necessary to propel the plow through hardpan and clay. However, no reduction of drawbar pull is realized under the more difficult conditions of rocky soil or roots. It is also reported that the vibratory plow must be built considerably sturdier than its "brute-force" counterpart, if it is to be used under rocky or rooty soil conditions.

Midwest will be demonstrating their Interline-II plow, equipped with vibrator, in Los Angeles in late January or early February of this year. San Dimas Equipment Development Center personnel will be on hand for this demonstration.

Allotment Expenditures, F.Y. 1967.

The following table indicates initial allocations to SDEDC authorized adjustments and revised totals:

ED&T NO.	PROJECT	INITIAL ALLOTMENT	AUTHORIZED ADJUSTMENT	REVISED ALLOTMENT
035	Rangeland Drill	\$8,300	\$1,571	\$9,871
328	Brushland Plow	1,700	-1,010	690
502	Browse Seeder	500	59	559
704	Ground Spray Equipment	4,600	-4,222	378
1010	Browse Seed Collector	3,000	8,434	11,434
1224	Front-End Plow	3,000	-2,598	402
1647	Contour Furrower	1,000	2,862	3,862
1787	Brush Roller	1,600	-1,564	36
1788	Contour Furrower-Drawbar	3,000	-2,583	417
1790	Anchor Chains	1,000	-810	190
1792	Vibrating Plow	2,000	-1,699	301
1421	Technical Services	3,000	1,560	4,560
TOTAL		\$32,700	--	\$32,700

Budgeted funds were inadequate to accomplish planned work for certain projects assigned to SDEDC. A reassessment of the program resulted in the diversion of funds allotted to some lesser priority projects to those of longer standing which are nearing completion. Shortage of Center personnel also adversely affected accomplishment of the planned program to some degree.

F.Y. 1968 Project Assignments.

Proposed projects for F.Y. 1968 were presented to the membership by Subcommittee Chairmen. Priority assignment and funding were discussed and finalized by the Committee to the extent possible at the meeting.

The total program proposed for F.Y. 1968 cannot be financed with available funds. Therefore, several projects of long standing were assigned first priority. Others of a lesser priority have been financed to the extent possible. Each Subcommittee Chairman will be provided a copy of his respective project work plan(s) for the year.

The program planned for F.Y. 1968 consists entirely of continuing projects. The itemization to follow indicates (1) financed projects, (2) those projects for which funds were not available, (3) projects not requiring funding, and (4) terminated projects.

FINANCED PROJECTS

Seeding Equipment Handbooks and Service Manuals.

Approved as presented by the Subcommittee. Required funds are included in respective project work plans; i.e., Rangeland Drill, Brushland Plow and Contour Furrower. Delegation of planned work assignments will be the responsibility of the Subcommittee Chairman.

Rangeland Drill, ED&T No. 035.

Planned work was approved as presented by the Subcommittee with major responsibility assigned to SDEDC. BLM, Vale, Oregon, and R-5, F. S., will cooperate in drawbar and cast disc arm performance tests as required. The allotted \$12,500 includes reproduction costs of the Parts Manual presently in proof (for drill models thru 1967) and processing of a new Service and Parts Manual for the F.Y. 1968 drill design. Detailed items are included in the work sheet.

Brushland Plow, ED&T No. 328.

The Subcommittee's plan of work was approved as presented. An allotment of \$3,300 will cover job costs itemized in the work sheet. Service and Parts Manual revision and reproduction costs (as presented by the Handbook-Manual Subcommittee) are included in the allotment. SDEDC is primarily responsible for planned work.

Browse Seed Collector, ED&T No. 1010.

The plan of work was approved as presented by the Subcommittee. SDEDC will be allotted \$9,000 to accomplish planned work itemized in the project work sheet. Field units are urged to acquaint the Center with seed crop potential as soon as possible. To expedite seed damage tests by species, 50 to 100 pound lots of uncleaned seed should be provided to the Center. The Subcommittee Chairman should coordinate both of the foregoing with his Committee membership and/or agency field units.

Model B Contour Furrower, ED&T No. 1647.

The Subcommittee's plan of work was approved as presented. An allotment of \$5,000 to SDEDC for planned work includes the preparation and reproduction costs of Parts and Maintenance-Operations Manuals. The Center will bear the primary responsibility for planned work.

Seed Dribbler, ED&T No. 1786.

The work plan was approved as presented by the Subcommittee. However, the planned effort could not be financed with available funds. The decision was made to use \$300 of Technical Service (ED&T No. 1421) funds to finance Equip Tip publication costs. Thus, current project results can be made available to users. Other work items planned must necessarily be deferred. It is suggested, however, that Region 4, F. S. and Utah Fish and Game Department continue to evaluate the performance of existing units to the extent possible on going projects. Responsibility for preparation of the Equip Tip is that of SDEDC.

Extended Lubrication Intervals, ED&T No. 1791.

The Subcommittee's work plan was approved as presented. An allotment of \$1,000 will be made to R-5, F. S. to perform the planned effort. It is expected that F.Y. 1968 tests will provide sufficient information to terminate the project. The Subcommittee Chairman will be responsible for coordination and accomplishment with the Bureau of Land Management and the Forest Service field units.

Spray Project Boundary Marking, ED&T 1875.

This project will essentially be new in F.Y. 1968. Efforts last year were of an exploratory nature to determine various measures currently being used to mark project boundaries and flight swaths. Preliminary arrangements were made by Region 1, Forest Service, to test aircraft automatic ejector equipment in July 1967. An allotment of \$1,000 will be allotted to R-1 for this purpose. A similar test is planned by Region 5, F. S. still in F.Y. 1967. This is not a RSEC-sponsored effort. However, it is suggested that results be obtained by the Subcommittee Chairman for inclusion in the accomplishment report at the next meeting.

Vibrating Plow, ED&T 1792.

The vibration principle as related to certain types of equipment was investigated to some extent last year. To complete the exploratory job, several other possibilities require investigation. The effort is assigned to SDEDC for which \$1,500 will be provided.

Technical Services, ED&T 1421.

The estimated needs as presented by SDEDC were approved. An allotment of \$6,200 provides for miscellaneous technical assistance to the overall RSEC program by Center personnel. In addition, cost of preparation and issuance of the Seed Dribbler Equip Tip is to be financed from these funds.

NON-FINANCED PROJECTS

1. Ground Spraying Equipment, ED&T No. 704.
2. Brush Roller, ED&T No. 1787.
3. Site Preparation Ripper, ED&T 1419.

Funds were not available to finance the above projects. Respective Subcommittees will be retained. Concerned chairmen are to assume the reporting responsibility for any progress that may result from interested individuals' or field units' efforts.

PROJECTS NOT REQUIRING FUNDING

Planned work on a number of projects will be accomplished in conjunction with normal programs of participating agencies at no cost to the RSEC. Respective Subcommittee Chairmen will assume the responsibility for reporting progress at the annual meeting. Projects in this category follow:

Brush Cutting - Beating Equipment, ED&T 501.

The project was relatively inactive last year. Limited use of the front-mounted unit was made by the Bureau of Indian Affairs in California. No particular problems were reported.

Planned work provides for continued use of the front-mounted unit in the chaparral type in California by BIA. The towed unit is to be used by Region 5, F. S. in decadent antelope bitterbrush stands as a means of rejuvenation (sprout stimulation).

Browse Seeder, ED&T No. 502.

Continued use of existing seeders under a variety of conditions is planned. Emphasis will be directed toward the unit's use as an inter-seeder.

Interseeder, ED&T No. 1566.

Continued testing of various types of equipment for interseeding is planned. The various aspects to be worked upon include methods of dispensing trashy seed, use of the browse seeder and scalping equipment.

Anchor Chain, ED&T No. 1790.

Planned effort consists of further testing and evaluation of chaining, using various innovations, by BLM and SCS. Attention is to be directed toward correction of problems encountered with swivels. Details are covered in the project work sheet.

Chemical Plant Control.

Efforts during the year will be concerned with continued investigation of more effective means of control for plants covered in the Handbook. Control information for other plants of a noxious nature will continue to be accumulated for eventual inclusion in the Handbook.

Cover Manipulation Project Inventory.

Planned efforts are itemized in the project work sheet. Major responsibility for accomplishment is to be borne by the Colorado Game, Fish and Parks Department.

Disturbed Area Rehabilitation.

The plan of work consists of continued investigation and case history reporting of rehabilitation measures and results. Participating agencies are encouraged to provide the Subcommittee Chairman with useful information from any source.

Equipment Transportation.

Information regarding methods of transporting equipment, materials and supplies will continue to be reviewed and disseminated. Committee membership is urged to provide the Subcommittee Chairman with useful information related to the subject.

Exploratory - Historical.

Planned work will consist of continued canvassing of membership for new projects for Committee consideration. New ideas related to equipment needs to further range management-improvement program accomplishment are solicited from the entire membership. Submit proposals to the Subcommittee Chairman at any time.

Completion of an Historical Index of the Committee's activities is anticipated. Essentially, it will consist of a brief, illustrated description of individual projects undertaken since the Committee's establishment.

Parts Stock Facility.

Efforts of this Subcommittee will be essentially similar to last year; i.e., supervision of the overall operation of the Stockton Equipment Depot parts facility. Ways and means of more accurately determining parts needs will continue to be explored with users. Suggestions by the latter should be submitted to the Subcommittee Chairman.

Poison Grain Dispenser.

Planned work consists of additional evaluation of scooter equipment in distributing poison grain. No problems were experienced with the dispenser last year.

Weed Chopper.

Work planned consists of modifying a pickup attachment to a John Deere 15 Rotary Chopper. An evaluation will be made of its effectiveness in removing accumulated weeds from fence lines.

TERMINATED PROJECTS

The following projects were terminated for the indicated reasons.

Fence Building Equipment, ED&T No. 1221.

Testing and evaluation of the Fury Fencer under a variety of wildland conditions have been continuous since 1962. Resulting modifications consisted of (1) a new 3 point hitch with an adequate power unit to

control the fencing unit, (2) altering the net wire dispensing unit for improved maneuverability and (3) hydraulic system improvement.

As modified, the unit has performed satisfactorily on relatively level terrain. Light construction of the unit resulted in some breakage problems. Performance of the fencer was unsatisfactory on side slopes and rough terrain. Continuation of the project is not warranted.

Front-end Plow, ED&T No. 1224.

Development of similar equipment resulted in termination of the project.

Root Plow.

Root plowing evaluations establish the effectiveness of this means of undesirable plant removal. Equipment efficiency has been realized by increasing the power supply and other refinements. Further investigation does not appear justified. Thus, the project has been terminated.

Other needs associated with manipulation of undesirable plant associations are concerned with suitability and selection of areas for treatment and adaptability of desirable forage species for introduction following treatment. However, such needs have not been considered within the realm of the Committee's charter. Rather, they are of a research nature for which some information should be currently available.

F.Y. 1968 PROGRAM BUDGET

<u>ED&T No.</u>	<u>Project Name</u>	<u>Priority</u>	<u>SDEDC</u>	<u>Funding</u>	<u>Other</u>
035	Rangeland Drill	1	\$12,500		
328	Brushland Plow	2	3,300		
1647	Model B Contour Furrower	3	5,000		
1875	Spray Project Boundary Marking	4		\$1,000	R-1
1010	Browse Seed Collection	5	9,000		
1786	Seed Dribbler	7A	<u>1/</u>		
1791	Extended Lubrication Intervals	7B		1,000	R-5
1792	Vibrating Plow	7C	1,500		
1421	Technical Services	--	<u>6,200</u>	<u> </u>	
			\$37,500	\$2,000	
					\$39,500

Project priorities, as assigned at the meeting, were considered to the extent possible with available financing. Inadequate funds necessitated exclusion of ED&T No. 704, Ground Spray Equipment. The above program will be financed with \$1,000, Bureau of Indian Affairs, \$17,000, Bureau of Land Management and \$21,500, Forest Service funds.

1/ Estimated \$300 to prepare Equip Tip to be financed from funds allotted to ED&T No. 1421, Technical Services.

SUBCOMMITTEE ASSIGNMENTS, FY 1968Anchor Chains Subcommittee

Ken Chambers, Chairman	BLM	Ely, Nevada (Box 1289)
Don Cain	BLM	Ely, Nevada (Box 1289)
Norman Hancock	Utah F&G	Salt Lake City, Utah
W. F. Currier	FS	Albuquerque, New Mexico
William Brady	BIA	Window Rock, Arizona
A. Perry Plummer	FS	Ephraim, Utah
Rudy Pederson	SCS	San Angelo, Texas

Browse Seeder Subcommittee

Perry Plummer	FS	Ephraim, Utah
H. Wayne Springfield	FS	Albuquerque, New Mexico
William Finley	FS	Fredonia, Arizona
Laurence Riordan	Colorado F&G	Denver, Colorado
Norman Hancock	Utah F&G	Salt Lake City, Utah
Joe Townsend	BLM	Denver, Colorado (Bldg. 50, FC)
Ralph Cole	SCS	Rapid City, South Dakota
Max Green	FS	Missoula, Montana
Walter Hanson	FS	Washington, D. C.
Karl G. Parker	ES	Logan, Utah
Harold L. Harris	SCS	Aberdeen, Idaho
A. Wendell Miller	SCS	Berkeley, California

Browse Seed Collection Subcommittee

Perry Plummer, Chairman	FS	Ephraim, Utah
Laurence Riordan	Colorado F&G	Denver, Colorado
Ed Schneegas	FS	Bishop, California
Walter Hanson	FS	Washington, D. C.
H. Wayne Springfield	FS	Albuquerque, New Mexico
Mel Cummings	Oregon F&G	Portland, Oregon
Mayo Call	BLM	Salt Lake City, Utah (Box 11505)
Clint Renny	SCS	Tucson, Arizona
Eldie W. Mustard	SCS	Denver, Colorado

Brush Cutter and Chipper Subcommittee

W. F. Currier, Chairman	FS	Albuquerque, New Mexico
Don Bolander	FS	San Francisco, California
Keith Finley	BLM	Albuquerque, New Mexico 87107 (1304 - 14th St. N.W.)
George Nordstrom	BIA	Sacramento, California
Waldo Frandsen	SCS	Portland, Oregon
Robert Gashwiler	FS	Atlanta, Georgia

Brush Cutting and Beating Subcommittee

George T. Nordstrom, Chairman	BIA	Sacramento, California
Don Bolander	FS	San Francisco, California
Carl Rice	BLM	Portland, Oregon (Box 3861)

Brush Roller Subcommittee

Charles Graham, Chairman	FS	PSW, Berkeley, California
Dan W. McKenzie	FS	San Dimas, California
Stu Porter	BLM	Sacramento, California

Chemical Plant Control Subcommittee

Donald R. Cornelius, Chairman	ARS	Berkeley, California
Don Hyder	ARS	Fort Collins, Colorado
Fred Tscherley	ARS	Tucson, Arizona
Robert Martin	BLM	Portland, Oregon (Box 3861)
Arnold Heerwagen	SCS	Lincoln, Nebraska
W. C. Robacker	ARS	Reno, Nevada
Lowell K. Halls	FS	Nacogdoches, Texas
Hurlon Ray	HEW	Washington, D. C.
Jon J. Norris	Colorado State U.	Fort Collins, Colorado
Karl J. Parker	ES	Logan, Utah
Claire Letson	BLM	Cheyenne, Wyoming (Box 1828)
Wade H. Hamor	SCS	Lincoln, Nebraska

Cover Manipulation Project Inventory Subcommittee

Harold Shephard, Chairman	Colorado F&G	Denver, Colorado
Max Bridge	BLM	Denver, Colorado (Fed. Bldg.)
John Miller	FS	Denver, Colorado
Edgar Gomer	BIA	Ignacio, Colorado
Thomas F. Eamon	SCS	Denver, Colorado

Disturbed Area Rehabilitation Subcommittee

Charles B. Waldron, Chairman	FS	Portland, Oregon
Willis G. Vogel	FS	Springfield, Missouri
S. H. Fuchs	SCS	Albuquerque, New Mexico
Lester Fluckiger	FS	Ogden, Utah
Don Bolander	FS	San Francisco, California
LeRoy Sweet	BLM	Denver, Colorado
John Miller	FS	Denver, Colorado

Equipment Parts Facility Subcommittee

Joseph H. Sonntag, Chairman	FS	San Francisco, California
Everett Doman	FS	San Francisco, California

Equipment Transportation Subcommittee

Howard DeLano, Chairman	BLM	Portland, Oregon
Joseph V. Chiarella	BIA	Phoenix, Arizona
Don Bolander	FS	San Francisco, California
Glen Lipscomb	BLM	Portland, Oregon (Box 3861)
W. F. Currier	FS	Albuquerque, New Mexico

Exploratory - Historical Subcommittee

William L. Mathews, Chairman	BLM	Washington, D. C.
Lester Fluckiger	FS	Ogden, Utah
Graham Rice	BIA	Portland, Oregon
A. C. Hull	ARS	Logan, Utah
Robert Williams	SCS	Washington, D. C.
Laurence Riordan	Colorado F&G	Denver, Colorado
Hurlon Ray	HEW	Washington, D. C.
E. G. Jackson	BIA	Billings, Montana

Extended Lubrication Intervals Subcommittee

Joseph H. Sonntag, Chairman	FS	San Francisco, California
Howard DeLano	BLM	Portland, Oregon
Etham Freeman	BLM	Vale, Oregon
Chester Cannon	FS	Tulelake, California

Ground Spraying Equipment Subcommittee

Don Bolander, Chairman	FS	San Francisco, California
George T. Nordstrom	BIA	Sacramento, California
Charles Waldron	FS	Portland, Oregon
Carl Rice	BLM	Portland, Oregon (Box 3861)
Roger Kirkman	FS	Springfield, Missouri
Charles Graham	FS	Berkeley, California
H. L. Leithead	SCS	Fort Worth, Texas
W. F. Currier	FS	Albuquerque, New Mexico

Interseeder Subcommittee

Ralph Cole, Chairman	SCS	Rapid City, South Dakota
Charles Waldron	FS	Portland, Oregon
Rex Cleary	BLM	Billings, Montana
Gordon Powers	BIA	Aberdeen, South Dakota
Max Green	FS	Missoula, Montana
W. F. Currier	FS	Albuquerque, New Mexico
Perry Plummer	FS	Ephraim, Utah
Peter Jensen	SCS	Lincoln, Nebraska

Model B Contour Furrower Subcommittee

Equipment Development Center

San Dimas, California

Poison Grain Dispenser Subcommittee

Gordon Powers, Chairman	BIA	Aberdeen, South Dakota
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Rangeland Drill - Brushland Plow Subcommittee

Howard DeLano, Chairman	BLM	Portland, Oregon
Don Bolander	FS	San Francisco, California
W. F. Currier	FS	Albuquerque, New Mexico
Graham Rice	BIA	Portland, Oregon
Warren Sandau	BLM	Portland, Oregon
J. Boyd Price	SCS	Reno, Nevada
Ethan Freeman	BLM	Vale, Oregon

Seed Dribbler Subcommittee

Lester Fluckiger, Chairman	FS	Ogden, Utah
Wilson C. Gutzman	BIA	Albuquerque, New Mexico (Box 8327)
A. Perry Plummer	FS	Ephraim, Utah
Nick Cozakos	BLM	Salt Lake City, Utah (Box 11505)
John Miller	FS	Denver, Colorado
Norman Hancock	Utah F&G	Salt Lake City, Utah

Seeding Equipment Handbook and Equipment Service Manuals Subcommittee

A. C. Hull, Chairman	ARS	Logan, Utah
George Nicholson	BIA	Washington, D. C.
William L. Mathews	BLM	Washington, D. C.
M. D. Atkins	SCS	134 So. 12th St., Lincoln, Nebr.
E. E. Silva	FS	San Dimas, California
Fred Pratt	ASCS	Washington, D. C.

Site Preparation Ripper Subcommittee

W. F. Currier, Chairman	FS	Albuquerque, New Mexico
Mark Stevens	BIA	Albuquerque, New Mexico (Box 1667)
Morris Trogstad	BLM	Santa Fe, New Mexico (Box 1449)
Ivan Dodson	SCS	Albuquerque, New Mexico

Spray Project Boundary Marking Subcommittee

Carl Rice, Chairman	BLM	Portland, Oregon
Max Green	FS	Missoula, Montana
Ivan Porter	SCS	Little Rock, Arkansas
D. B. Polk	SCS	Bryan, Texas
Eric Granfelt	BIA	White River, Arizona

Vibrating Plow Subcommittee

Equipment Development Center		San Dimas, California
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Weed Chopper Subcommittee

Bob Martin		Portland, Oregon (Box 3861)
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ATTENDANCE REGISTERAgricultural Research Service

A. C. Hull, Jr.	Crops Research Laboratory, USU, Logan, Utah
Donald R. Cornelius	Berkeley, California 94701
Wesley Keller	Logan, Utah
William J. McGinnies	Ft. Collins, Colorado

Agricultural Stabilization and Conservation Service

Fred Pratt	Washington, D. C.
George E. Bradley	Washington, D. C.

Bureau of Indian Affairs

Graham Rice	P. O. Box 3785, Portland, Oregon
Glenn Jackson	300 N. 26th St., Billings, Montana
Bill M. Brady	Window Rock, Arizona
Paul L. Howard	Washington, D. C.
Wilson C. Gutzman	P. O. Box 1260, Albuquerque, New Mexico
Joseph V. Chiarella	P. O. Box 7007, Phoenix, Arizona
Mark Stevens	Albuquerque, New Mexico
George H. Nicholson	Washington, D. C.

Bureau of Land Management

Robert D. Martin	P. O. Box 3861, 710 N.E. Holladay, Portland, Oregon 97208
Warren K. Sandau	P. O. Box 2965, 729 N.E. Oregon, Portland, Oregon 97208
Howard R. DeLano	P. O. Box 2965, Portland, Oregon 97208
Carl M. Rice	P. O. Box 3861, Portland, Oregon 97208
Kenneth F. Hansen	Washington, D. C.
Nick Cozakos	Salt Lake City, Utah
Myrvin E. Noble	120 Montgomery St., Denver, Colorado
James R. Brunner	Denio Ave., Winnemucca, Nevada
John K. Chambers	Ely, Nevada
John C. Clark	Glenwood Springs, Colorado
George D. Lea	Washington, D. C.
D. G. Wilson	Washington, D. C.

Federal Extension Service

Karl G. Parker	Logan, Utah
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Fish and Game DepartmentsColorado Game, Fish and Parks Department

Laurence E. Riodan	6060 Broadway, Denver, Colorado 80216
Harold R. Shepherd	Ft. Collins, Colorado

Utah Fish and Game Department

Homer D. Stapley	Salt Lake City, Utah
Jordon C. Pederson	Salt Lake City, Utah
Norman V. Hancock	Salt Lake City, Utah

Forest Service

Charles A. Graham	PSWF&RES, Berkeley, California
George A. Garrison	PNW Experiment Station, LaGrande, Oregon
Charles W. Howard	Washington, D. C.
Harold A. Dahl	Portland, Oregon
Jake Callantine	John Day, Oregon
John C. Miller	Denver, Colorado
William E. Selby	Malheur, Oregon
Elmer E. Hokanson	Equipment Development Center, San Dimas, California
Dan W. McKenzie	Equipment Development Center, 444 E. Bonita Ave., San Dimas, California 91773
Hallie L. Cox	Ogden, Utah
J. H. Sonntag	San Francisco, California
R. M. DeNio	Washington, D. C.
Charles B. Waldron	Portland, Oregon
George N. Engler	Missoula, Montana
W. O. Hanson	Washington, D. C.
J. S. Forsman	Washington, D. C.
R. C. Monteith	517 Gold S.W., Albuquerque, New Mexico
W. F. Currier	Albuquerque, New Mexico
A. Perry Plummer	Ephraim, Utah
A. B. Evanko	San Francisco, California
Edwin B. Abbott	Medford, Oregon 97501

Industry

J. T. Shipman	Bates, Inc., Albuquerque, New Mexico
J. D. Welton	Dow Chemical Co., 307 Broad St. Seattle, Washington
Jim Scott	Hercules Powder Co., San Francisco, Calif.
Gerald W. Sharp	Sharp Brothers' Seed Co., Healy, Kansas

Soil Conservation Service

Daniel L. Merkel	Box 1328, Santa Fe, New Mexico
Roy L. Shipley	Boise, Idaho
Claude Dillon	Spokane, Washington
Waldo R. Fraudsen	Portland, Oregon
Boyd Price	Box 4850, Reno, Nevada
C. S. Fonte	Box 271, Sterling, Colorado
H. H. Wegeleben	314 RED. Bldg., Yakima, Washington
M. Don Atkins	134 S. 12th St., Lincoln, Nebraska
H. Ray Brown	Salina, Kansas
Warren Peden	Rushville, Nebraska
Lamar R. Mason	Salt Lake City, Utah
H. L. Leithead	Ft. Worth, Texas

UniversitiesUniversity of Arizona

Gilbert L. Jordan	Dept. of Watershed Mgmt., Tucson, Arizona
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Montana State University

Richard L. Hoddes	Bozeman, Montana
John E. Taylor	Bozeman, Montana